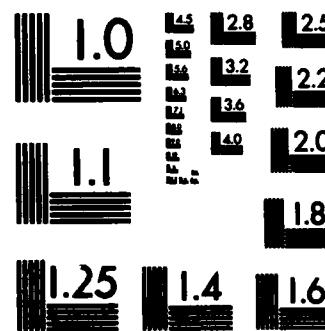


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WITH INTERMODAL ISO CONTAINERS (U) NAVAL CIVIL  
ENGINEERING LAB PORT HUENEME CA R H SEABOLD ET AL.  
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**TITLE:** AXIAL TENSION TESTING OF HORIZONTAL CONNECTORS  
FOR USE WITH INTERMODAL ISO CONTAINERS

**AUTHOR:** R. H. Seabold and B. Posadas

**DATE:** July 1983

**SPONSOR:** Marine Corps Development and Education Command

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# NOTE

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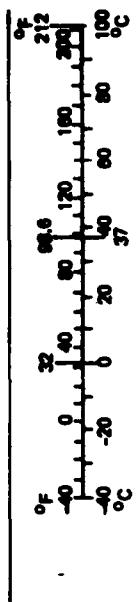
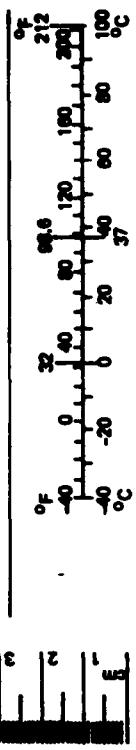
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### METRIC CONVERSION FACTORS

#### Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol	When You Know	Multiply by	To Find	Symbol
		<u>LENGTH</u>				<u>LENGTH</u>		
in	inches	2.56	centimeters	mm	millimeters	0.04	inches	in
ft	feet	30	centimeters	cm	centimeters	0.4	inches	in
yd	yards	0.9	meters	m	meters	3.3	feet	ft
mi	miles	1.6	kilometers	km	kilometers	1.1	yards	yd
		<u>AREA</u>				<u>AREA</u>		
in <sup>2</sup>	square inches	6.56	square centimeters	cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
mi <sup>2</sup>	square miles	2.56	square kilometers	km <sup>2</sup>	hectares (10,000 m <sup>2</sup> )	2.5	acres	ac
	acres	0.4	hectares	ha				
		<u>MASS (weight)</u>				<u>MASS (weight)</u>		
oz	ounces	28	grams	g	grams	0.035	ounces	oz
lb	pounds	0.45	kilograms	kg	kilograms	2.2	pounds	lb
	short tons	0.9	tonnes	t	tonnes (1,000 kg)	1.1	short tons	
	(12,000 lb)							
		<u>VOLUME</u>				<u>VOLUME</u>		
tp	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces	fl. oz
Tbsp	tablespoons	15	milliliters	ml	liters	2.1	pints	pt
fl oz	fluid ounces	30	milliliters	ml	liters	1.06	quarts	qt
c	cups	0.24	liters	l	cubic meters	0.26	gallons	gal
pt	pints	0.47	liters	l	cubic meters	36	cubic feet	ft <sup>3</sup>
qt	quarts	0.95	liters	l	cubic meters	1.3	cubic yards	yd <sup>3</sup>
gal	gallons	3.8	liters	l				
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>	<u>TEMPERATURE (exact)</u>			
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>	°C	9/5 (then add 32)	Fahrenheit temperature	°F
		<u>TEMPERATURE (exact)</u>						
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C				

\*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Metric Pub. 285, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10-286.



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FOR USE WITH INTERMODAL ISO CONTAINERS, by  
R. H. Seabold and B. Posadas

TN-1670 12 pp illus July 1983 Unclassified

1. Connectors

2. Transportation

I. C0939-2-55-031

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## INTRODUCTION

### Objective

The objective was to determine whether a certain commercial horizontal connector meets the tension resistance requirements for use with intermodal International Organization for Containerization (ISO) containers in the Marine Corps Container System and the Naval Mobile Construction Battalion (NMCB) Table of Allowance (TOA) Container System.

### Scope

Sixteen specimens of a single design were tested statically at a standard loading rate in a tension testing machine. The connectors were pulled by standard ISO corner fittings that, in turn, were pulled by the machine. Maximum applied forces were measured, recorded, and then compared with the rated capacity.

### Background

Similar connectors for the same purpose were tested previously (Ref 1) with negative results. The connectors reported on herein are improved connectors with a manufacturer's ultimate capacity rating of 50,000 pounds. The system requirements are 48,100 pounds for the Marine Corps system (Ref 2) and 42,700 pounds for the Navy system (Ref 3).

The critical condition for the Marine Corps is the lateral restraint in the marine mode when 12 connectors are used to couple four Marine Corps quadruple containers (QUADCONs), in which case operational loads govern and a factor of safety of 2.0 is applied. The Marine Corps QUADCON has a gross weight rating of 10,000 pounds, not the maximum of 11,200 pounds allowed in the ISO standard, and a nonstandard height of 82 inches, not the standard 92 inches. The quad (four QUADCONs coupled end-to-end) will be certified in the marine, highway, and rail modes of transportation in accordance with ISO 1496/I-1978(E) (Ref 4). It will be operated as an uncertified container with American military aircraft in accordance with Military Specification MIL-A-8421F (Ref 5), and will be uncoupled into separate QUADCONs for shipment by commercial aircraft. Furthermore, the quad will be carried on a rail car with each QUADCON lashed to the car.

The critical condition for the Navy is the longitudinal restraint in the fixed wing air mode when eight connectors are used to couple three Navy triple containers (TRICONs), in which case ultimate loads govern and a factor of safety of 1.5 is applied. The Navy TRICON has a gross weight rating of 8,287 pounds, not the maximum of 15,700 pounds allowed in the ISO standards. The container equivalent (three TRICONs coupled end-to-end) will be certified in the marine, highway, and rail

modes of transportation in accordance with ISO 1496/I-1978(E) (Ref 4). It will be operated as an uncertified container with American military aircraft in accordance with Military Specification MIL-A-8421F (Ref 5), and will be uncoupled into separate TRICONs for shipment by commercial aircraft. For a container equivalent consisting of TRICONs and connectors, there is no special lashing requirement for the rail mode.

## EXPERIMENT

### Test Specimens

The connector was Line Fast Corporation Tandemloc Connector Heavy Duty Model 7129-1-45M-PSS (Figure 1) (Ref 6), which was improved by the manufacturer during 1982 to increase the ultimate tension capacity to 50,000 pounds. Sixteen specimens were chosen at random from a total population of 31.

### Apparatus

Testing Machine and Grippers. A Baldwin-Tate-Emery testing machine was used to apply and measure the tension load. The capacity of the machine is 120,000 pounds, and the dial gage can be read to the nearest 100 pounds. The gage has one pointer that indicates the applied load and a second pointer that remains at the maximum load and must be reset by hand. A constant loading rate of 10,000 lb/min was used during the tests. Grippers were required to grip the bars that were used in conjunction with the corner fittings.

Corner Fittings and Tension Bars. The maximum tension force occurs in connectors located between bottom corner fittings; therefore, the connectors were tested between two bottom corner fittings that were secured in the machine by means of tension bars that were welded to them. The corner fittings were Line Fast Corporation ISO Container Corner Fittings Model 75030-SUS, which are supplied in sets of eight. Each set has tops and bottoms, lefts and rights, for each end of one container. A single set was procured, and one left bottom and one right bottom were chosen for use as test apparatus. The test set up is shown in Figure 2. Figure 3 shows the same assembly mounted vertically in the testing machine. The tension bars were centered on the centers of the holes in the corner fittings; therefore, the load was applied to the specimen without any eccentricity.

### Procedure

The specimens were numbered 1 through 16 and tested one at a time sequentially in accordance with the following procedure:

1. Mount the connector between the two corner fittings, using a socket wrench to close the connector.
2. Mount the connector and the corner fittings in the test machine, using the tension bars and the grippers as shown in Figure 3.

3. Preset the load at 500 pounds, back off, and check alignment and security.
4. Load the specimen at 10,000 lb/min from zero to the failure load or 50,000 pounds, whichever occurs first.
5. Record the maximum load and remove the specimen.

The corner fittings were used in more than one test.

#### Findings

The test results are listed in Table 1. Four specimens were tested to failure, ten others were tested to 50,000 pounds, and two were not tested because their operating mechanisms were too tight and, thus, they could not be fully opened. This operational problem was outside the scope of the test.

The original plan was to load the specimens to the failure load or 60,000 pounds, but the corner fittings were not able to resist repeated loading above 50,000 pounds. The hole in one of the corner fittings was distorted after three tests were conducted above 50,000 pounds; therefore, two new corner fittings were prepared and the load limited to 50,000 pounds thereafter.

The average ultimate capacity of the four connectors that were tested to failure was 52,900 pounds. That average exceeds the 42,700-pound Navy requirement, the 48,100-pound Marine Corps requirement, and the 50,000-pound rated capacity. For each test, the maximum applied tension is listed in Table 2 as a percentage of the requirements.

#### CONCLUSION

The connector meets the tension resistance requirements for use with both systems.

#### RECOMMENDATION

The Line Fast Corporation Tandemloc Connector Heavy Duty Model 7129-1-145M-PSS should be qualified for use with the Marine Corps Container System and the NMCB TOA Container System.

#### ACKNOWLEDGMENTS

Messrs. Daniel Polly, Valente Hernandez, and John Crahan operated the testing machine and took the measurements. Mr. William Pike, of Line Fast Corporation, provided technical assistance and observed some of the tests.

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Table 1. Maximum Tension Recorded During the Tests

Specimen No.	Maximum Tension (lb)
1	55,500 <sup>a</sup>
2	57,500 <sup>a</sup>
3	not tested
4	51,000 <sup>a</sup>
5	50,000
6	not tested
7	50,000
8	50,000
9	47,500 <sup>a</sup>
10	50,000
11	50,000
12	50,000
13	50,000
14	50,000
15	50,000
16	50,000

<sup>a</sup>Tested to failure.

Table 2. Maximum Tension as a Percentage of the Requirements

Specimen No.	Maximum Tension as a Percentage of--		
	Navy Requirement	Marine Corps Requirement	Rated Capacity
1	130	115	111
2	135	120	115
4	119	106	102
5	117	104	100
7	117	104	100
8	117	104	100
9	111	99	95
10	117	104	100
11	117	104	100
12	117	104	100
13	117	104	100
14	117	104	100
15	117	104	100
16	117	104	100

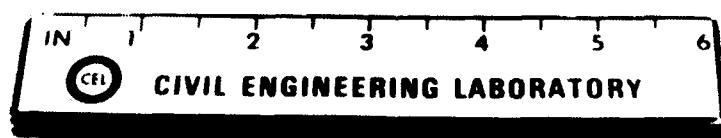
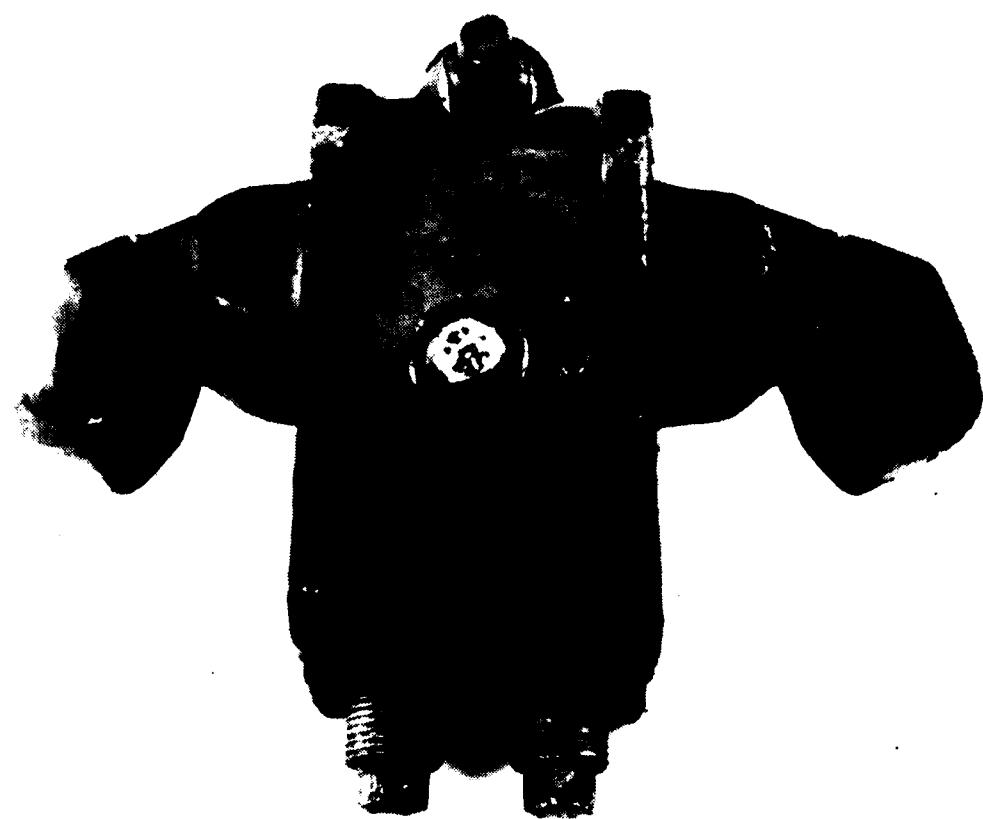


Figure 1. Line Fast Tandemloc connector, heavy duty,  
model no. 7129-1-45M-PSS.

**LEGEND**

- A - Tension bar
- B - Right bottom corner fitting
- C - Test specimen
- D - Left bottom corner fitting

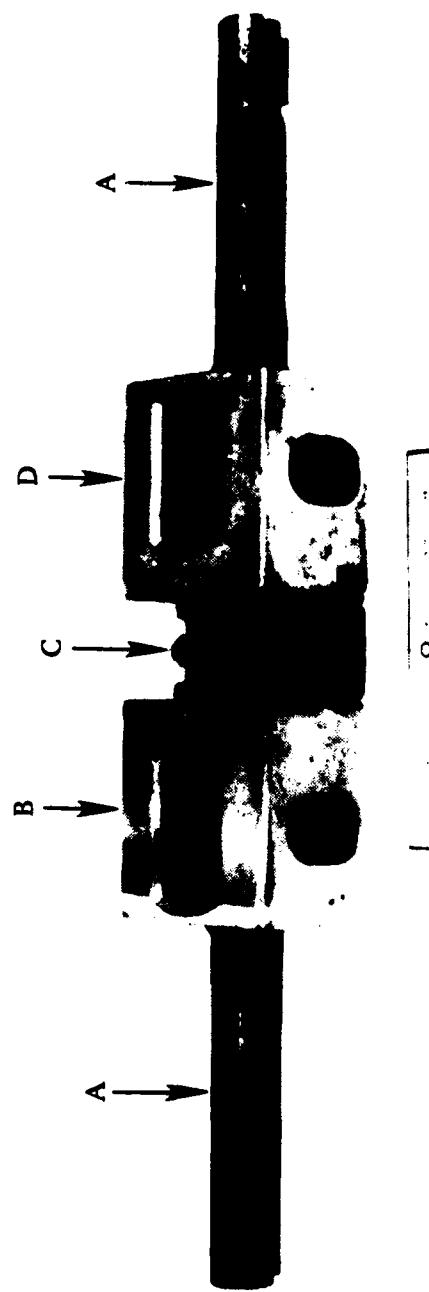


Figure 2. The corner fittings and tension bar test setup with the Line Fast Tandemloc connector.



**Figure 3. Specimen and corner fittings mounted vertically in the Baldwin-Tate-Emery testing machine.**

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NAVSEASYSOM Code C132 (Mr. J. Peters) Washington, DC; Code SEA OOC Washington, DC; SEA 04E (L Kess) Washington, DC  
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NAVSHIPYD Code 202.5 (Library) Puget Sound, Bremerton WA; Code 380, Portsmouth, VA; Code 410, Mare Is., Vallejo CA; Code 440, Norfolk; Code 440, Puget Sound, Bremerton WA; Tech Library, Vallejo, CA

NAVSTA Code 4, 12 Marine Corps Dist, Treasure Is., San Francisco CA; Dir Engr Div, PWD, Mayport FL;  
Engr. Dir., Rota Spain; Long Beach, CA; PWD (LTJG.P.M. Motolenich), Puerto Rico; PWO, Keflavik  
Iceland; PWO, Mayport FL; SCE, Subic Bay, R.P.

NAVSUPPFAC PWD - Maint. Control Div, Thurmont, MD

NAVSURFWPNCEN G-52 (Duncan) Dahlgren, VA

NAVTECHTRACEN SCE, Pensacola FL

NAVWPNCEN Code 2636 China Lake; Code 266, China Lake, CA; Code 3803 China Lake, CA

NAVWPNSTA PW Office Yorktown, VA

NAVWPNSTA PWD - Maint. Control Div., Concord, CA

NAVWPNSUPPCEN Code 09 Crane IN

NCTC Const. Elec. School, Port Hueneme, CA

NCBC Code 10 Davisville, RI; Code 15, Port Hueneme CA; Code 155, Port Hueneme CA; Code 1552 (Brazele)  
Port Hueneme, CA; Code 155B (Nishimura) Port Hueneme, CA; Code 156, Port Hueneme, CA; Code 156F  
(Volpe) Port Hueneme, CA; Code 1571, Port Hueneme, CA

NCBU 411 OIC, Norfolk VA

NCR 20, Code R70; 20, Commander: 30th Det, OIC, Diego Garcia I

NMCB 3, SWC D. Wellington; 74, CO; FIVE, Operations Dept; Forty, CO; THREE, Operations Off.

NROTC J.W. Stephenson, UC, Berkeley, CA

NSC Code 44 (Security Officer) Oakland, CA; Code 54.1 Norfolk, VA

NTC OICC, CBU-401, Great Lakes IL

NUSC Code SB 331 (Brown), Newport RI

OFFICE SECRETARY OF DEFENSE ASD (MRA&L) Code CSS/CC Washington, DC; OASD (MRA&L)  
Dir. of Energy, Pentagon, Washington, DC

ONR Central Regional Office, Boston, MA

PHIBCB 1 P&E, San Diego, CA; 1, CO San Diego, CA

PWC CO Norfolk, VA; CO, (Code 10), Oakland, CA; CO, Great Lakes IL; CO, Pearl Harbor HI; Code 10,  
Great Lakes, IL; Code 120, Oakland CA; Code 128, Guam; Code 154 (Library), Great Lakes, IL; Code  
30V, Norfolk, VA; Code 400, Pearl Harbor, HI; Code 420, Great Lakes, IL; Code 420, Oakland, CA; Code  
424, Norfolk, VA; Code 500 Norfolk, VA; Code 505A Oakland, CA; Code 600, Great Lakes, IL; Code 700,  
Great Lakes, IL; Code 700, San Diego, CA; Library, Code 120C, San Diego, CA; Library, Guam; Library,  
Norfolk, VA; Library, Oakland, CA; Library, Pearl Harbor, HI; Library, Pensacola, FL; Library, Subic  
Bay, R.P.; Library, Yokosuka JA; Utilities Officer, Guam

SPCC PWO (Code 120) Mechanicsburg PA

SUPANX PWO, Williamsburg VA

TVA Solar Group, Arnold, Knoxville, TN

UCT ONE OIC, Norfolk, VA

US DEPT OF INTERIOR Bur of Land Mgmt Code 583, Washington DC

US NAVAL FORCES Korea (ENJ-P&O)

USCG G-EOE-2/61 (Espinshade), Washington, DC; Gulf Strike Team, Bay St. Louis, MS; Lant Strike Team  
Elizabeth City, NC; Pac Strike Team, Hamilton AFB, CA

USCG R&D CENTER D. Motherway, Groton CT; S Rosenberg, Groton, CT

USDA Forest Service Reg 3 (R. Brown) Albuquerque, NM; Forest Service, Bowers, Atlanta, GA; Forest  
Service, San Dimas, CA

USNA USNA/SYS ENG DEPT ANNAPOLIS MD

LINEFAST CORP (J. DiMartino) Holbrook, NY

ROHR IND. INC (D. Buchanan) Chula Vista, CA

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